CCS Technical Documentation
RH-25 Series Transceivers

Troubleshooting - Baseband

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Baseband Top-Level Description

RH-25 is a handportable dual band TDMA and AMPS DCT-4 generation phone for the smart classic segment.

The RH-25 Baseband consists of the DCT4 common Baseband chipset having some product-specific blocks of its own, such as pop-port system connector (also unofficially known as "Tomahawk"), IHF, IrDA, and a color display.

The Baseband engine consists basically of two major ASICs:

- Universal Energy Management IC (UEM), including the analog audio circuits, the charge control, and the voltage regulators.
- Universal Phone Processor (UPP), containing DSP, MCU, and some internal memory.

Baseband Block Diagram

The system block diagram below shows the main BB functional blocks.

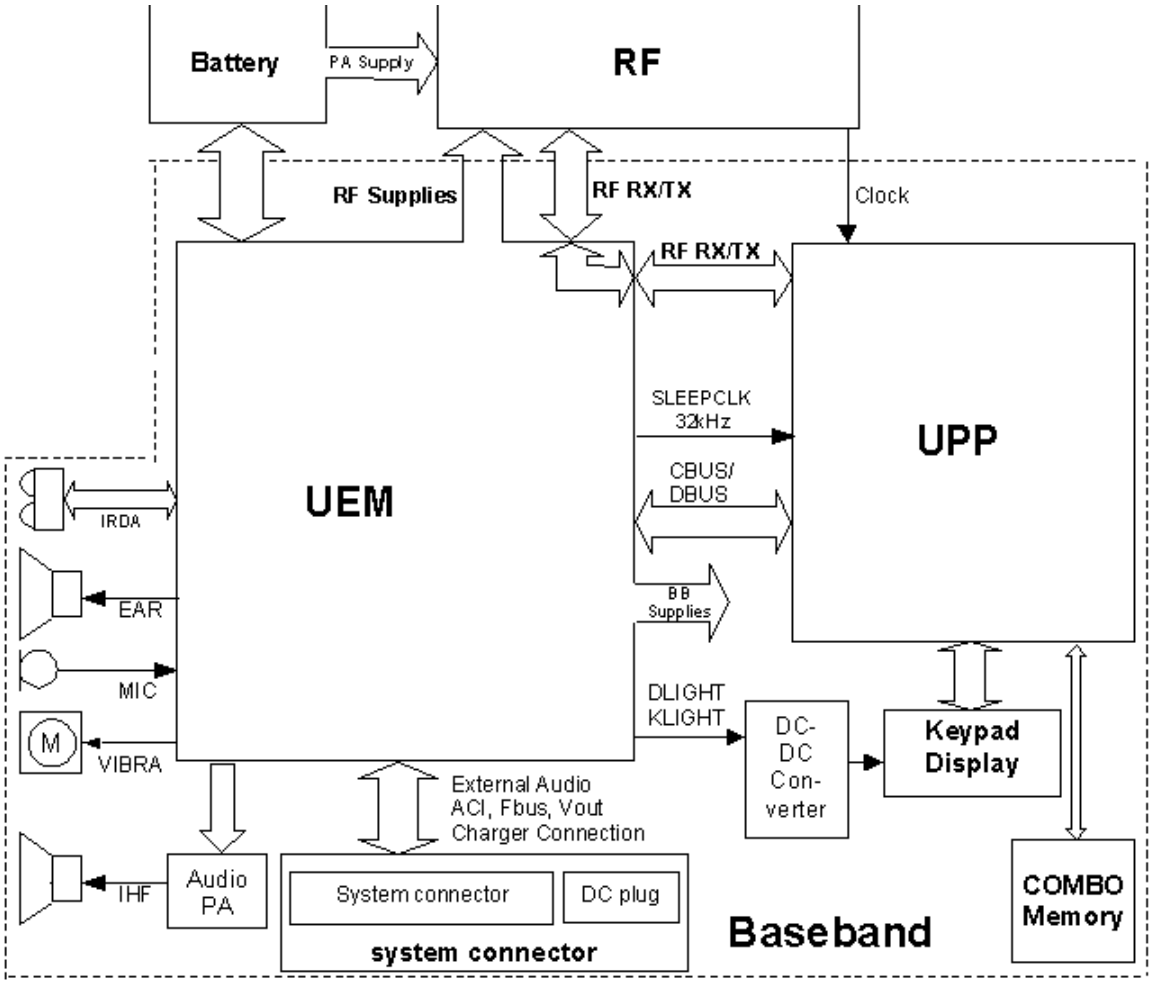

Figure 1: Baseband block diagram

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Environmental Specifications

Normal and Extreme Voltages

Following voltages are assumed as normal and extreme voltages for the BLD-3 battery used in RH-25:

- Nominal voltage: 3.6 V
- Lower extreme voltage: 3.1 V
- Higher extreme voltage (fast charging): 4.4 V

Temperature Conditions

Operational temperature range (all specifications met within this range) -10°C..+55°C

Functional temperature range (Reduced performance) -30°C..+70°C

Storage temperature range: -30°C..+85°C

Humidity

Relative humidity range is 5...95%.

The Baseband module is not protected against water. Condensed or splashed water may cause interim or permanent phone malfunction.

Submergence of the phone in water will likely cause permanent damage to the phone.

Frequencies in Baseband

There are several clock frequencies at the baseband part. The following table lists all available frequencies. The asynchronous and diagnostic busses are not included.

Table 1: Frequency List

Frequency	Context	UPP	UEM	Flash	Comments
54 MHz	Memory clock	X		X	
19.44 MHz	RF clock	X			
13MHz	DBUS, RFBusClk	X	X		
Up to 1MHz	RFConvClk	X	X		
1.08MHz	CBUS Clock	X	X		AMPS mode: 1.25MHz
32kHz	Sleep Clock		X		
1.2kHz	ACI	X	X		
1.625MHz up to 6.5MHz	Display IF	X			Frequency depends on SW

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Infrared Interface (IrDA)

RH-25 supports data connectivity via an infrared link. An IR module is integrated into the phone, connected to the IR interface of the UPP ASIC.

Energy Management

The energy management of RH-25 is based on BB 4.0 architecture. A semi-fixed battery (BLD-3) supplies power primarily to UEM ASIC and the RF PA. UEM includes several regulators to supply RF and baseband. It provides the energy management including power up/down procedure.

Power Supply Modes

The functional behavior of the UEM can be divided into seven different states. Since the UEM controls the regulated power distribution of the phone, each of these states affects the general functionality of the phone:

- No supply
- Backup
- Power off
- Reset
- Power on
- Sleep
- Protection

The different states of the UEM are detailed in the sections below.

No Supply

In the NO_SUPPLY mode, the UEM has no supply voltage (VBAT < V_{MSTR} and VBACK < V_BU_{COFF-}). This mode is due to the fact that both the main battery and the backup battery are either disconnected or both discharged to a low voltage level.

The UEM will recover from NO_SUPPLY into RESET mode if the VBAT voltage level rises above the V_{MSTR+} level by either reconnecting the main battery or charge it to such level.

Backup

In BACK_UP mode the main battery is either disconnected or has a low voltage level (VBAT < V_{MSTR-} and VBACK > V_BU_{COFF+}).

The regulator VRTC that supplies the real-time clock is disabled in BACK_UP mode. Instead the unregulated backup battery voltage VBACK supplies the output of the VRTC. All other regulators are disabled and the phone has no functionality.

The UEM will recover from BACK_UP mode into RESET mode if VBAT rises above V_{MSTR+}.

Power Off

In order for the UEM to be in PWR_OFF mode, it must have supply voltage (VBAT > V_{MSTR+}).

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The regulator VRTC regulator is enabled and supplying the RTC within the UEM. The UEM will enter RESET mode after a 20 ms delay whenever one of the below listed conditions is logically true:

- The power button is activated
- Charger connection is detected
- RTC alarm is detected

The UEM will enter PWR_OFF from all other modes except NO_SUPPLY and BACK_UP if the internal watchdog elapses.

Reset

When the UEM enters RESET mode from PWR_OFF mode, the watchdog is enabled. If the VBAT fails to rise above the power-up voltage level V_{COFF+} (3.1 V) before the watchdog elapses, the UEM will enter PWR_OFF mode. Otherwise, after a 200 ms delay, the regulator VFLASH1 will be enabled and after an additional delay of 500 µs, the regulators VANA, VIO, VCORE, and VR3 will be enabled. All other regulators(i.e., VFLASH2, VSIM, VR1, VR2, and VR4 - VR7) are software controlled and disabled by default. After an additional delay of 20 ms, the UEM enters PWR_ON mode.

Power On

In PWR_ON, the UEM is fully functional in the sense that all internal circuits are powered up or can be by means of software. The UEM will enter PWR_OFF mode if VBAT drops below V_{COOF-} for a period of time longer than 5 µs. The UEM will furthermore enter PWR_OFF mode if either of the watchdogs Operational State Machine (approx. 100 µs), Security (32 sec.), or Power Key (4 sec.) elapses or if any of the regulators trigger the thermal protection circuitry

Sleep

The UEM can be forced into SLEEP mode by the UPP by setting the input SLEEPX low for more than 60 µs. This state is entered when the external UPP activity is low (phone in sleep) and thereby lowering the internal current consumption of the UEM. The regulator VANA is disabled and VR1 - VR7 are either disabled or in low quiescent mode.

From SLEEP the UEM enters PWR_ON if SLEEPX goes high, PWR_OFF mode if watchdog elapses or BACK_UP mode if VBAT drops below V_{MSTR-}.

Protection Mode

The UEM has two separate protection limits for over temperature conditions: one for the charging switch and one for the regulators. The temperature circuitry measures the on-chip temperature. In case of charging over temperature, the circuit turns the charging switch off. In case of over temperature in any of the regulators, the UEM powers off.

Battery BLD-3

RH-25 uses the BLD-3 Li-ion battery with a capacity of 780mAh. BLD-3 is a case-less battery; the main advantage of a case-less battery type is the overall size, particularly the thickness and the number of contact terminals.

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BLD-3 has a four-pin connector. BSI resistor value is 75Kohm.

Power Distribution

Under normal conditions, the battery powers the baseband module. Individual regulators located within the UEM regulate the battery voltage **VBAT**. These regulators supply the different parts of the phone. Eight regulators are dedicated to the RF module of the phone, and six to the baseband module.

The regulator **VCORE** is likewise adjustable and controlled by registers written by the MCU. VCORE supplies the core of the UPP and can be adjusted on the fly by the MCU if DSP capacity is inadequate. Higher VCORE supply (1.8 V) results in faster core operations in the UPP.

Regulators **VANA, VFLASH1,** and **VIO** are solely controlled by the UEM and cannot be enabled or disabled by the MCU. Furthermore, VFLASH1 and VIO are both ON, though in low quiescent mode when phone is in sleep mode. An output current of 500 µA can be drawn from the regulators. VIO supplies the UPP, FLASH and LCD, VFLASH1 supplies LCD and the IrDA module. VANA is supplying analog parts internally in the UEM as well as the baseband audio circuitry and pull-up resistors on the input of the UEM slow AD converters.

System connector provides a voltage to supply accessories. The white LED's need a higher voltage supply as the battery can provide in bad condition. Separate external regulators supply both consumers.

The regulators **VR1A, VR1B, VR2 – VR7** and **IPA1 – IPA4** are controlled by the DSP via the DBus. VR4 - VR7 are controlled by the UEM as well and are disabled in sleep regardless of DSP writings.

VBAT/VBATTRF is furthermore distributed, unregulated, to the RF power amplifier, audio power amplifier and external baseband regulators.

The CHACON module in the UEM controls the charging of the main battery. Furthermore it contains a 3.2 Vdc regulator for charging of the backup battery and a 1.8 Vdc regulator supplying the internal real time clock.

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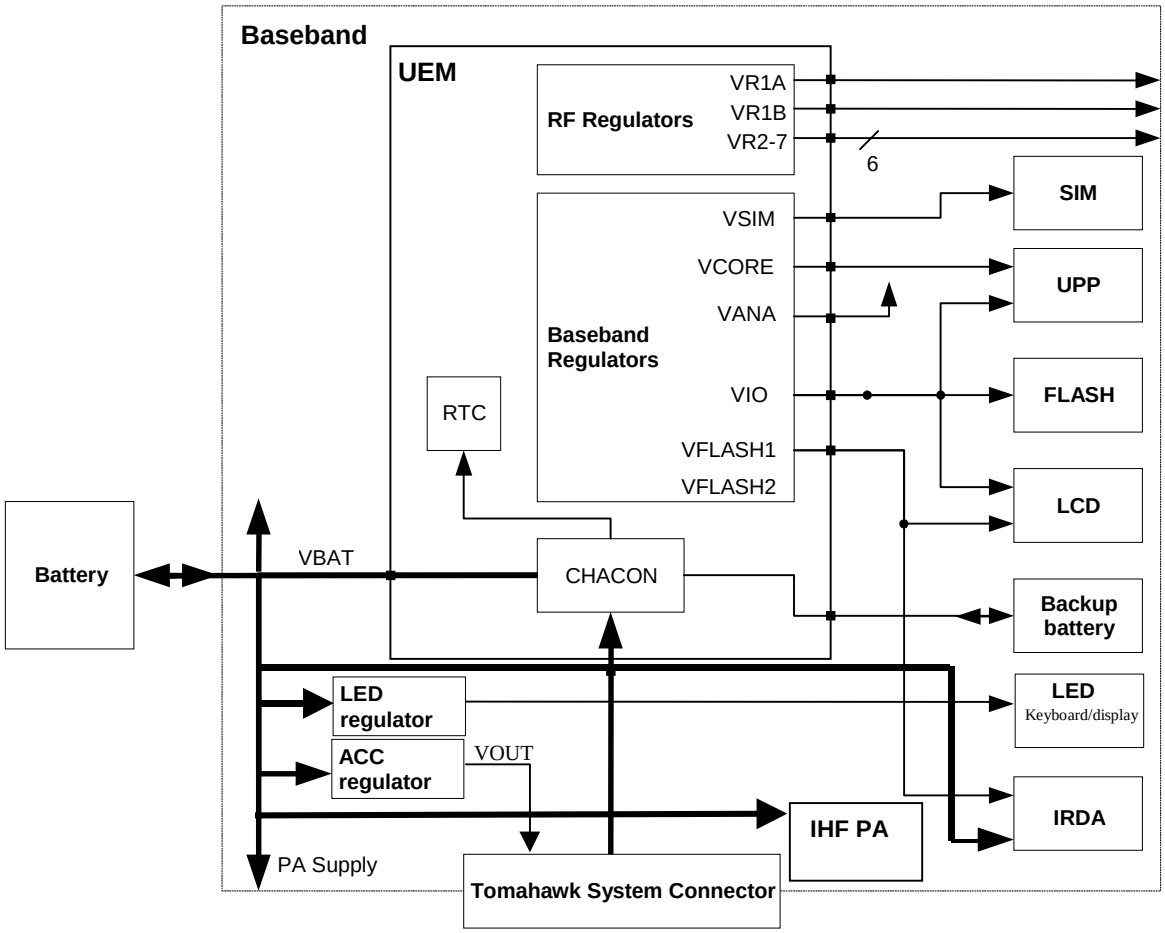

Figure 2: Baseband power distribution

DC Characteristics

The following table reflects the specifications of voltage and current regulators within the UEM:

Table 2: UEM regulator outputs

Regulator	Target	Output Voltage (V)			Output Current (mA)	
		Min	Typ	Max	Min	Max
VR1A	RF	4.6	4.75	4.9	0	10
VR2[4]	RF	2.70	2.78	2.86	0.1	100
VR3	RF	2.70	2.78	2.86	0.1	20
VR4	RF	2.70	2.78	2.86	0.1	50 0.1
VR5, VR6[1]	RF	2.70	2.78	2.86	0.1	50 0.1
VR7	RF	2.70	2.78	2.86	0.1	45
VrefRF01	RF	1.334	1.35	1.366	-	0.1

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Regulator	Target	Output Voltage (V)			Output Current (mA)	
		Min	Typ	Max	Min	Max
VIO[1]	BB	1.72	1.8	1.88	0.005 0.005	150 0.500
VSIM[2]	BB	1.745 2.91	1.8 3.0	1.855 3.09	0.005 0.005	25 0.500
VANA	BB	2.70	2.78	2.86	0.005	80
VCORE[2]	BB	1.000 1.235 1.425 1.710	1.053 1.3 1.5 1.8	1.106 1.365 1.575 1.890	0.005 0.005 0.005 0.005	70 85 100 120
		0.974 1.215 1.410 1.692	1.053 1.3 1.5 1.8	1.132 1.365 1.575 1.890	70 85 100 120	200 200 200 200
VFLASH1	BB	2.70	2.78	2.86	0.005 0.005	70 1.5
VFLASH2[3]	BB	2.70	2.78	2.86	0.005	40

1 The second current value indicates the maximum possible output current of the regulator when in low quiescent mode.

2 The output voltages are split into two different current categories. The upper part is the lower range of output current, and the lower part is the higher range of output current.

3 Condition in sleep-mode depends on MCU writings to UEM regulator register solely.

4 Condition in sleep-mode depends on DSP writings to UEM register.

When the accessory regulator, N100, is active, it will turn Vout ON (2.8V) and provide 70mA current.

Audio Circuitry

This section describes the audio-HW inside the Baseband. (External audio components and acoustics are not considered with the details in this section.)

The main topology comes from other phones using BB4.0 engine, where the audio-HW is mostly integrated into the UEM-ASIC. The biggest difference is that RH-25 has integrated hands-free (IHF).

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Audio Block Diagram

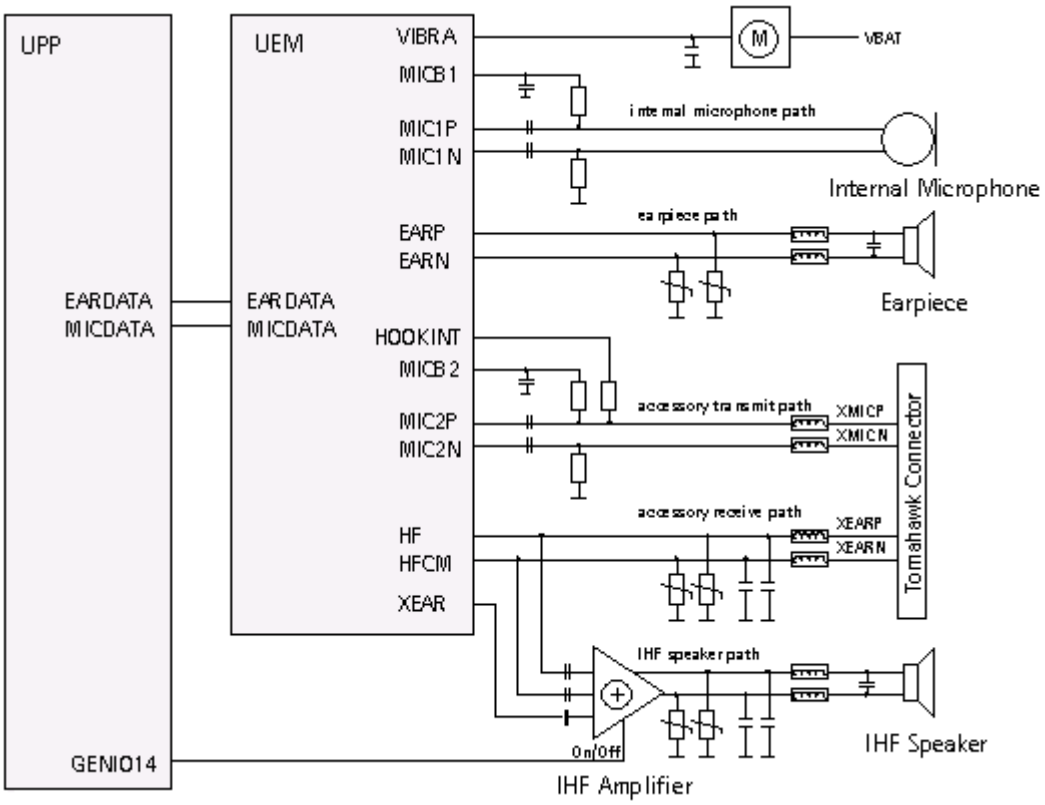

Figure 3: Audio block diagram

Earpiece

RH-25 uses an earpiece, which is also referred to as a PICO speaker. This is a 32 ohm speaker with the diameter of 8 mm.

Earpiece is fed by the differential signals EARP and EARN from UEM. The signals run quite directly from UEM to the earpiece, only some passive ands EMC protection components are needed

The external earpiece signals are fed by the HF and HFCM pins.

The level (swing) of earpiece-signals can be adjusted by register values inside UEM. These signals have a common voltage level of 1.35 V (0.8 V for HF) at UEM pins.

Microphones

An EMC-improved type of microphone is used as internal microphone in RH-25, diameter of which is 2.2mm.

Internal microphone circuitry is driven single-ended. Microphone needs bias voltage, which is provided by UEM and is fed through a resistor to the microphone. A resistor is also needed to the other side of the microphone, (i.e., between microphone and GND), in order to provide the differential signals to UEM. Audio signals are AC-coupled from the microphone.

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For the external microphone a differential input is used.

MIC1N and MIC1P (audio signals) and MICB1 (bias voltage) are used for the internal microphone. MIC2N and MIC2P and MICB2 are used for external microphone.

Integrated Hands-free (IHF)

The speaker used for IHF is a 16 mm diameter speaker with 8 Ohm impedance, also known as a MALT speaker.

IHF circuitry uses differential outputs from UEM.

Depending on the audio mode, the IHF amplifier is driven either from UEM HF / HFCM or XEAR audio outputs. The IHF audio power amplifier (APA) LM4855 has a bridge-tied-load (BTL) output in order to get the maximum use of supply voltage. The supply voltage for driving circuitry of speaker is VBAT, thus the swing across the speaker is (VBAT.

The shutdown of the IHF PA is controlled by UPP using GENIO14.

Audio Accessory Receive Path

In RH-25, the accessory receive path is directly driven from UEM HF / HFCM differential audio outputs, the output signal complies with the Pop-port accessory interface.

For EMC protection, ferrites are connected in series to the earpiece; for ESD protection, varistors are used.

Audio Control Signals

The HEADINT signal is needed for recognizing the external device (e.g., headset) connected to the system. The recognition is based on the ACI-pin on the system connector, which is shorted to ground inside the external device.

The button of the external device generates HOOKINT. This is used to answer or to end a phone call.

Acoustics

Earpiece Acoustic

RH-25 uses the PICO 8mm earpiece.

This earpiece is mounted into the UI-shield assembly, the sealing of the front volume is achieved using a foam gasket mounted on the front of the speaker. The UI shield is sealed using a rubber sealing between UI shield and A-cover to create an acoustic path.

IHF Speaker Acoustics

The MALT speaker is used in RH-25 for integrated hands-free and ringing tone applications.

The IHF speaker is mounted to the IHF enclosure on a foam sealing ring. The IHF enclo-

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sure provides the needed back volume for the speaker. The IHF enclosure is closed with the IHF lid, which is carrying the IHF pins to contact the IHF speaker.

The sealing of the effective acoustic volumes is achieved using ultrasonic welding to bond the IHF lid and the IHF enclosure permanently.

To provide long-term reliability, additionally the IHF lid is heat stacked to the IHF enclosure. There is a dust membrane mounted inside the acoustic chamber that provides dust and drop protection.

Due to ultrasonic welding of the IHF enclosure, it cannot be disassembled and, in case of failure, the C-cover assembly should be replaced as one complete assembly.

Microphone Acoustics

A standard microphone module is used. This module is embedded into a rubber boot and connected to the RH-25 system module by spring contacts.

The microphone is placed close to the system connector. The sound port of the microphone is located towards the bottom of the phone.

Vibra Motor

A vibrating alerting device is used to generate a vibration signal for an incoming call.

This vibra is located in the bottom section of the phone.

The vibrator is driven by the UEM output VIBRA, and controlled with a PWM signal. The supply of the vibra is taken from the battery voltage of the phone.

Audio Modes

The following audio configurations can create the audio modes:

- Handportable
- Integrated hands-free
- Headset
- Loop set
- External hands-free

The following audio sources have to be routed according to the active audio mode:

- Speech
- Ringing tones / SMS tones
- Keypad tones
- Error tones / Warning tones
- Game tones

Handportable Mode

In handportable mode, earpiece path and internal microphone path are in use. The audio sources are routed according to the following table:

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Table 3: Handportable mode audio routing

Audio Source	Earpiece	Internal Microphone	IHF speaker	Accessory receive path	Accessory transmit path
Speech	X	X			
Ringing tones, SMS tones			X		
Keypad tones	X				
Warning/Error tone			X		
Game tones			X		

Integrated Hands-free Audio Mode

In integrated hands-free mode, IHF path and internal microphone path are used. The audio sources are routed according to the following table:

Table 4: IHF mode audio routing

Audio Source	Earpiece	Internal Microphone	IHF speaker	Accessory receive path	Accessory transmit path
Speech		X	X		
Ringing tones, SMS tones			X		
Keypad tones			X		
Warning/Error tones			X		
Game tones			X		

Headset Audio Mode

In headset mode, accessory receive path and accessory transmit path are used. RH-25 supports the following headsets:

HDB-4: HS-10, HS-5, and HS-2R headsets

The audio sources are routed according to the following table:

Table 5: Headset audio mode routings

Audio Source	Earpiece	Internal Microphone	IHF speaker	Accessory receive path	Accessory transmit path
Speech		X		X	X
Ringing tones, SMS tones			X	X	
Keypad tones				X	
Warning/Error tones				X	
Game tones				X	

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Loop set Audio Mode

In loop set mode, accessory receive path and accessory transmit path are used. RH-25 supports the loop set LPS-4.:

Table 6: Loop set mode audio routing

Audio Source	Earpiece	Internal Microphone	IHF speaker	Accessory receive path	Accessory transmit path
Speech				X	X
Ringing tones, SMS tones			X	X	
Keypad tones				X	
Warning/Error tones				X	
Game tones				X	

External Hands-free Audio Mode

In external hands-free mode, accessory receive path and accessory transmit path are used. RH-25 supports external hands-free accessories:

BHF-1: Basic car hands-free kit

Table 7: External hands-free mode audio routing

Audio Source	Earpiece	Internal Microphone	IHF speaker	Accessory receive path	Accessory transmit path
Speech				X	X
Ringing tones, SMS tones				X	
Keypad tones				X	
Warning/Error tones				X	
Game tones				X	

System Connector Interface

System Connector

The system connector in RH-25 is called Pop-Port System Connector (unofficial name: "Tomahawk"). It is a galvanic interface between phone and accessories.

Compared with previous system connector versions, four new functions are introduced with the Pop-port system connector interface:

- Accessory Control Interface (ACI)
- Power Out
- Stereo audio output
- Universal Serial Bus (USB).

USB functionality and stereo audio output of the Pop-port are not supported in RH-25.

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Pop-port system connector is **mechanically and electrically not backward-compatible** with any earlier Nokia accessory interfaces, except the charger connector.

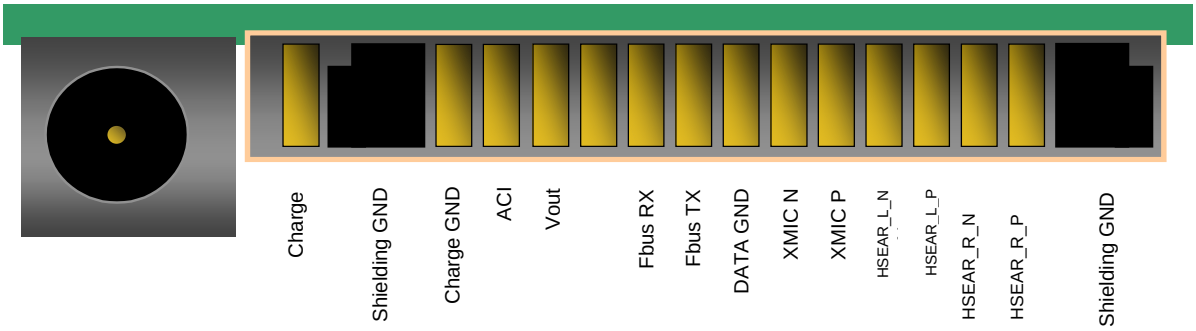

Figure 4: Tomahawk (Pop-port) system connector

Table 8: Tomahawk system connector interface description

Pin #	Signal	Notes
1	VCHAR	Charger input line
2	GND	Charge ground
3	ACI	Insertion and removal detection/ Serial data bi-directional 1 kbit/s
4	Vout	Accessory power supply
5		Not used in RH-25
6	FBUS_RX	Serial data from accessory to phone / 115 kbit/s
7	FBUS_TX	Serial data from phone to accessory / 115 kbit/s
8	GND	Data ground
9	XMIC N	Negative audio in signal
10	XMIC P	Positive audio in signal
11	HSEAR_L_N	Negative left channel audio out signal Max bandwidth from the phone
12	HSEAR_L_P	Positive left channel audio out signal Max bandwidth from the phone
13	HSEAR_R_N	Negative right channel audio out signal
14	HSEAR_R_P	Positive right channel audio out signal

Accessory Control Interface (ACI)

ACI is a point-to-point, master-slave, and bi-directional serial bus. It has three features:

- The insertion and removal detection of an accessory device
- Acting as a data bus, intended mainly for control purposes
- The identification and authentication of accessory type which is connected

The accessories are detected by the HeadInt signal when the plug is inserted.

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Normally when no plug is present, the pull-up resistor 100k pulls up the HeadInt signal to VFLASH1. If the accessory is inserted, the external insertion and removal resistor works as voltage divider and decreases the voltage level below the threshold Vhead.

The comparator output will be changed to high state causing an interrupt.

If the plug is removed, the voltage level of HeadInt increases again to VFLASH1. This voltage level is higher than the threshold of the comparator and therefore its output will be changed to low. This change leads to an interrupt. These HeadInt interrupts initiate the accessory detection or removal sequence.

If no accessory is inserted / connected, the only active part on the Pop-port interface is the ACI line.

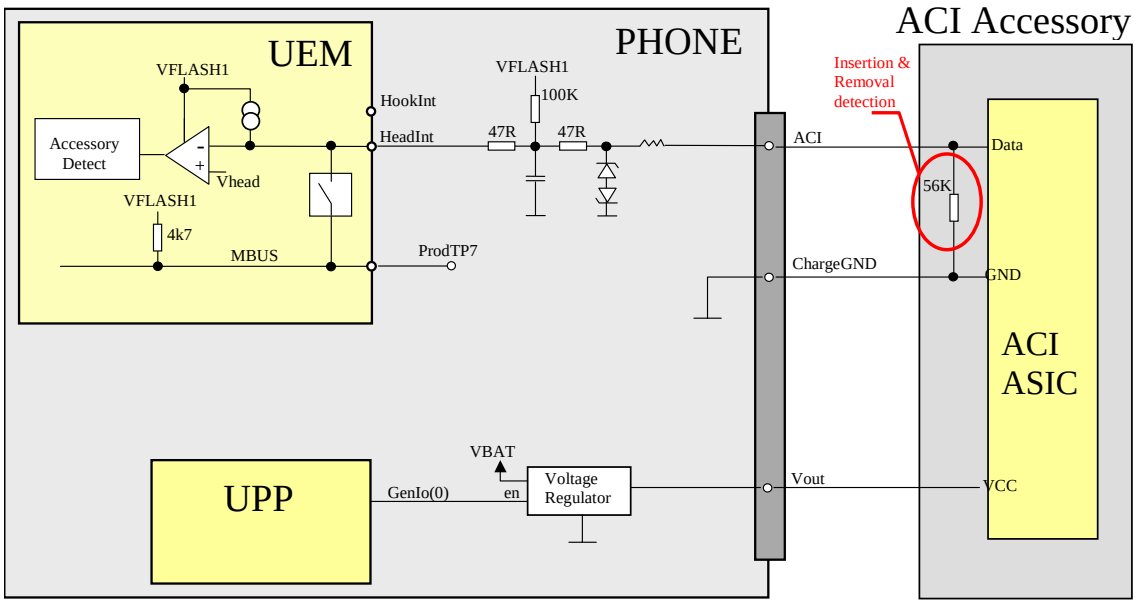

Figure 5: Principle schematics of ACI accessory and engine

Signal flow on ACI line - ACI-ASIC accessory inserted

1. Accessory is connected (insertion and removal resistor connect to ACI line)

1a) Phone gets HeadInt interrupt after 20ms check that ACI line is still low (<Vhead min)

2. Connect MBUS with HeadInt line (MBUS switch)

2a) If the phone detects a HeadInt interrupt from low to high transition in 20ms time-frame, then an advanced accessory is connected

3. ACI chip reset (3000- 4000us)

4. Power up delay (50-400us)

5. Start bit (50us)

6. Learning sequence (567-1700us)

7. ACI communication

8. MBUS is disconnected from HeadInt line (MBUS switch). After every communication.

9. Accessory is removed (no insertion and removal resistor on ACI line) --> phone gets

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HeadInt interrupt from ACI line low to high transition.

9a) If no HeadInt interrupt comes in the next 100ms, the accessory is really removed and the phone goes in the state "no accessory".

Table 9: Voltage levels

Signal	Min	Typ	Max	Unit	Notes
V_{FLASH1}	2.7	2.78	2.86	V	
V_{head}	1.75	1.9	2.05	V	
Specified values for levels	Min	Typ	Max	Unit	
V_{act_detect}	0.83		1.13	V	Voltage level if MBUS not connected to HeadInt (MBUS switch open), but ACI accessory is inserted.
V_{high}	2.45		2.71	V	Voltage level after MBUS connected to HeadInt
V_{low}		<0.22*VDD		V	

Signal flow on ACI line - Non ACI-ASIC accessory inserted

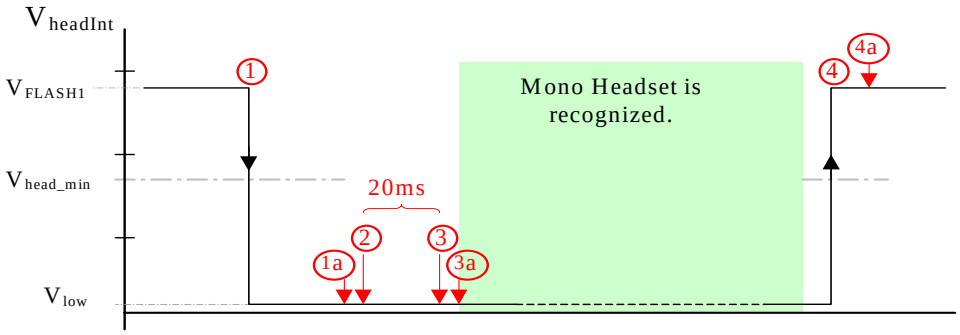

Figure 6: Signal flow on ACI Line

1. Accessory is connected (insertion and removal resistor connect to ACI line)

1a) Phone gets HeadInt interrupt after 20ms check that ACI line is still low (<Vhead min)

2. Connect MBUS with HeadInt line (MBUS switch)

3. The 20 ms timer elapsed and no transition has been on HeadInt line

3a) Disconnect MBUS from HeadInt line

4. Accessory is removed. Phone gets HeadInt interrupt from ACI line low to high transition.

4a) If no HeadInt interrupt comes in the next 100ms, the accessory is really removed.

FBUS

FBUS is an asynchronous data bus with separate TX and RX signals. Default bit rate of the bus is 115.2 Kbit/s.

FBUS is used as additional communication channel from phone to accessory and vice versa. There are two types of accessories which it uses:

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1. Nokia Serial Bus Accessory, AT mode
2. Fbus Phonet mode accessory

From HW-point of view, this does not make any difference.

Table 10: FBUS interface

Signal	Parameter	Min	Typ	Max	Unit
FBUS_RX	V_{IH}	1.95	2.78	3.0	Vout
	V_{IL}	0	0.2	0.83	
FBUX_TX	V_{OH}	1.95	2.78	2.83	
	V_{OL}	0	0.2	0.83	

VOUT (Accessory Voltage Regulator)

DCT4 chip set does not provide and power supply for accessories. To enable this, an external LDO regulator is needed. This regulator is called Accessory Regulator.

The regulator input is connected directly to battery voltage (VBAT) and the output to VOUT pin at system connector. The regulator is controlled by the GENIO(0) line of UPP. With this signal, the regulator can be switched on and off.

The regulator can be supply up to150 mA. (Note: this exceeds the Pop-port minimum requirement.)

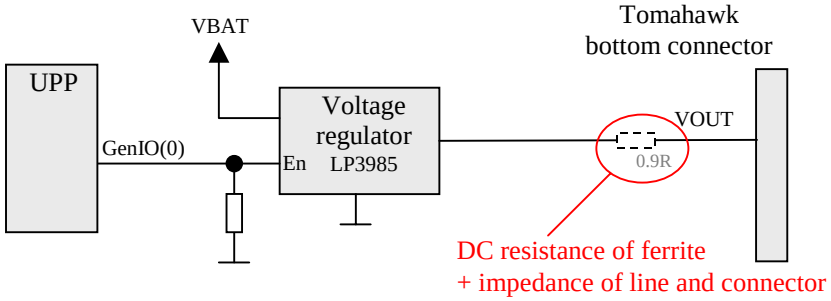

Figure 7: Accessory power supply diagram

Table 11: Accessories power supply

Signal	Min	Nom	Max	Unit	Note
Vout	2.63 2.56	2.80	2.88	V	I = 70mA Imax = 150mA
GenIO(0)	1.4	1.88 0.6	0.6	V	High (ON) Low (OFF)

The pull-down resistor on the enable input of the regulator is needed because in the switch-off mode of the phone, the output level of the Genio(0) is not defined. Without this resistor the output of the regulator can be floating.

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RH-25 supports fully differential external audio signals. A headset can be connected to the Pop-port system connector. However, only Mono audio is supplied to accessories.

HookInt

This signal is used to detect whether a button in accessory is pressed or not. The hook signal is generated by creating a short circuit (20 ohm) between the headset microphone signals (XMICP and XMICN). In this case, an LP-filter is needed on the HookInt input to filter the audio signal.

If no accessory is present, the HookInt signal is pulled up by the UEM resistor.

If an accessory is inserted and the microphone path is biased, the HookInt signal decreases to 1.9V due to the microphone bias current flowing through the resistor. When the button is pressed, the microphone signals are connected together, and the HookInt input will get half of micbias dc value 1.1V. This change in DC level will cause the Hook-Int comparator output to change state, in this case from 0 to 1.

HookInt comparator reference is selected level is 1.35 V.

Normally micbias and hookint are enabled only when audios are routed to headset.

In order to recognize the Hook signal (button in headset or SyncButton in deskstand), when the phone is in the sleep mode, it must be done by polling. That means the micbias and the hookInt signal must be enabled in regular time intervals.

Table 12: Voltage levels Hook Int

Signal	Min	Nom	Max	Unit
VFLASH1	2.7	2.78	2.86	V
MICB2	2.0	2.1	2.25 600	V uA
Vhook1	1.25	1.35	1.45	V

Charging

RH-25 can be charged via a DC-plug or charging pins on the system connector. It supports only 2-wire charging.

DC-Plug

RH-25 uses a 3.5mm DC-plug. It is possible to use a 3-wire charger, but the PWM inside these chargers is not supported.

VCHAR Pins of System Connector

The VCHAR and ChargeGND pin are directly connected to the normal charger lines of the

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DC-plug.

Table 13: Charger input voltage levels

Signal	Min	Nom	Max	Unit	Notes
Input voltage range (fast charger)	5.5	8.4	9.3	VRMS	1 = 850mA
Input voltage range (standard charger)		11.1 7.9	16	Vpeak VRMS	
	-0.3		20	V	Absolute maximum VCHAR voltage

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Voltages and Currents

Table 14: System connector interface signals

Pin #	Signal	Parameter	Min	Typ	Max	Unit	Notes
1	VCHAR		0		9 0.85	VDC ADC	
2	GND						Charge ground
3	ACI	Logic "0" Logic "1"	0 1.7	0.2 2.78	0.7 2.86	V	Insertion and removal detection/ Serial data bi-directional 1 kbit/s
4	Vout	Output voltage Current	2.56	2.8 70	2.88 150	VDC mA	70mA is specified as the max current in the Pop-port specification
5							Not used in RH-25
6	FBUX_RX	Logic "0" Logic "1"	0 2.0	0.2 2.78	0.86 3.0	V	Serial data from accessory to phone / 115 kbit/s
7	FBUS_TX	Logic "0" Logic "1"	0 1.89	0.2 2.78	0.81 2.83	V	Serial data from phone to accessory / 115 kbit/s
8	GND						Data ground
9	XMIC N	Differential voltage swing DC level		1		Vpp VDC	Negative audio in signal
10	XMIC P	Differential voltage swing DC level	 2.05	1 2.1	 2.25 400	Vpp VDC uA	Positive audio in signal
11	HSEAR_L_N	Differential voltage swing	1			Vpp	Left channel negative audio out signal
12	HSEAR_L_P	Differential voltage swing	1			Vpp	Left channel positive audio out signal
13	HSEAR_R_N	Differential voltage swing	1			Vpp	Right channel negative audio out signal
14	HSEAR_R_P	Differential voltage swing	1			Vpp	Right channel positive audio out signal

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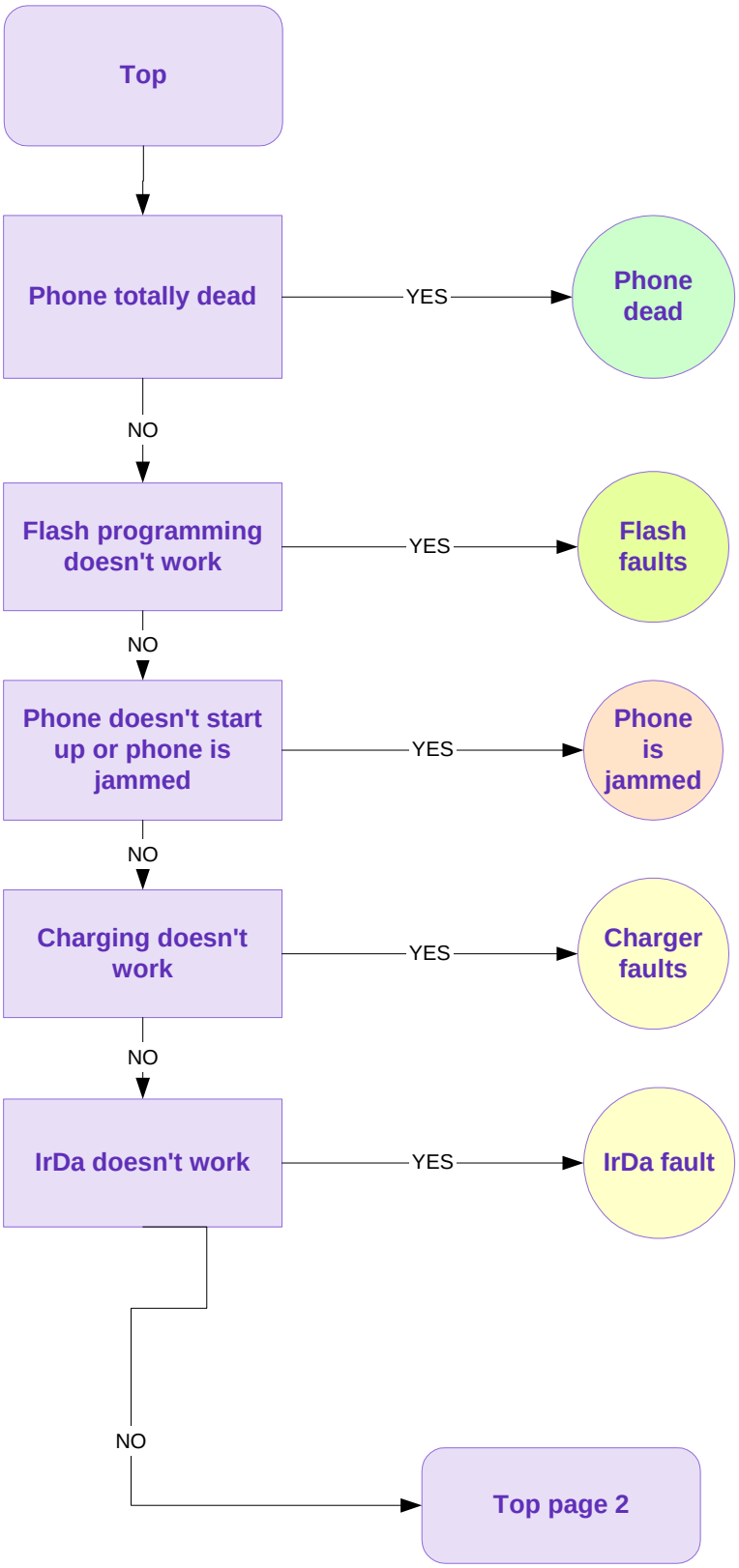
Main Troubleshooting Diagram



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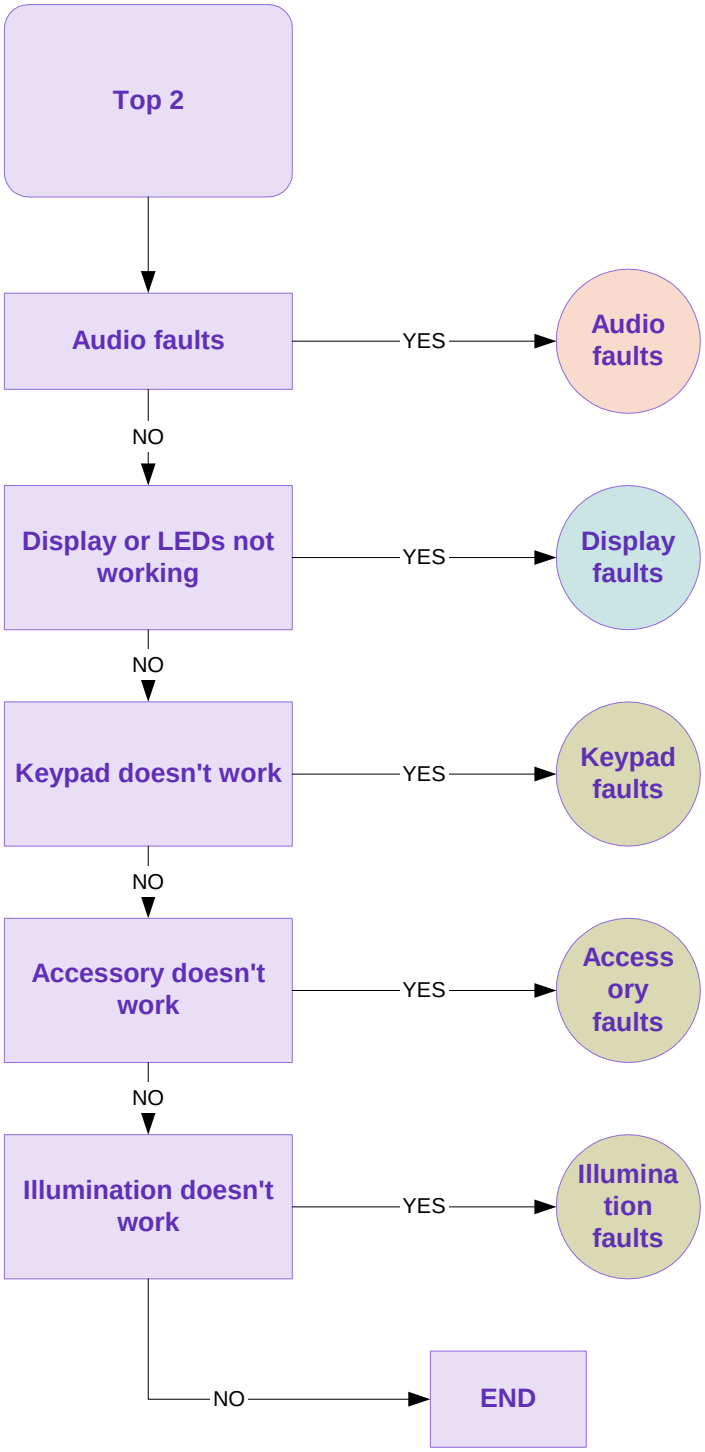

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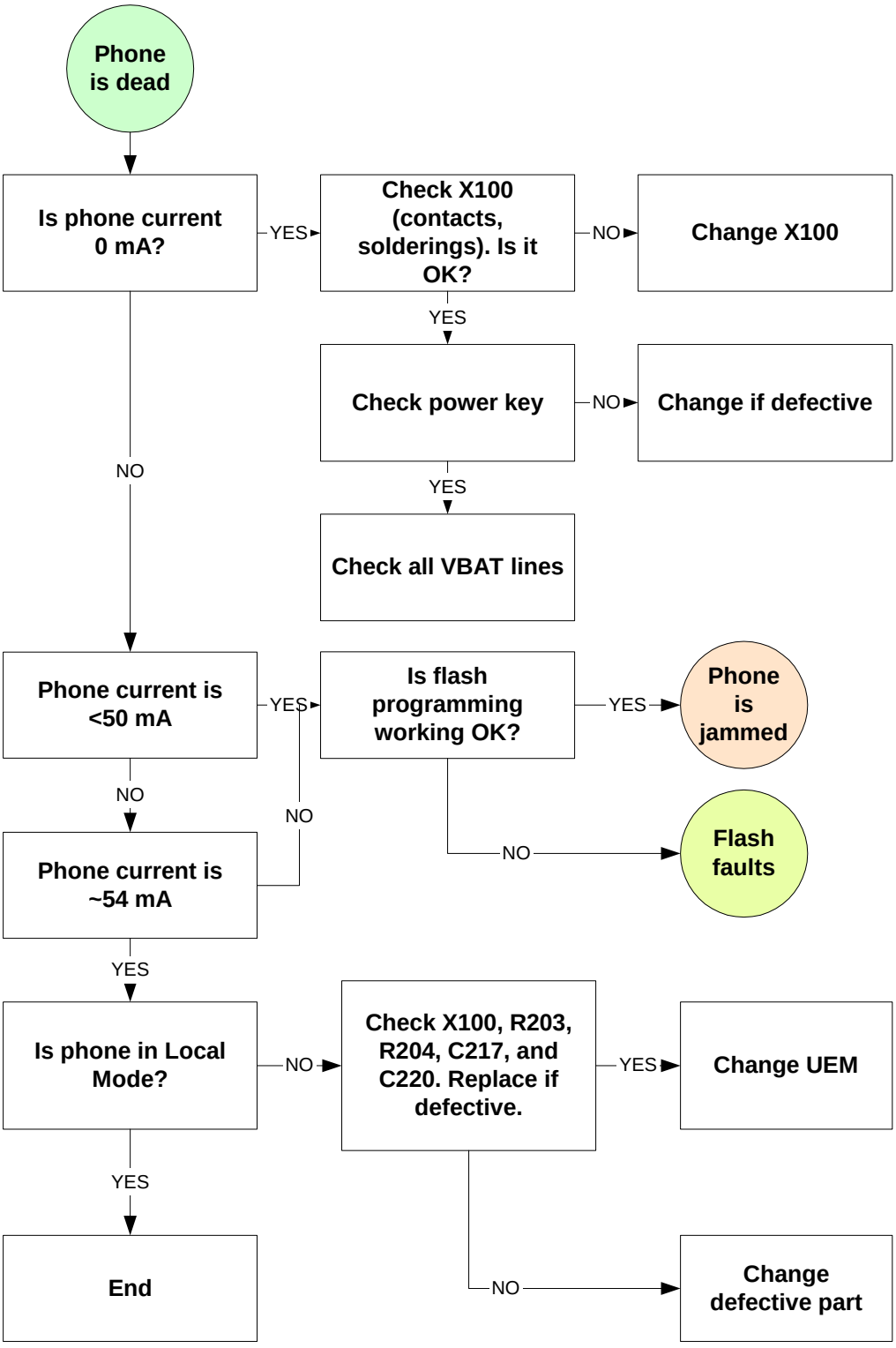
Phone is Dead



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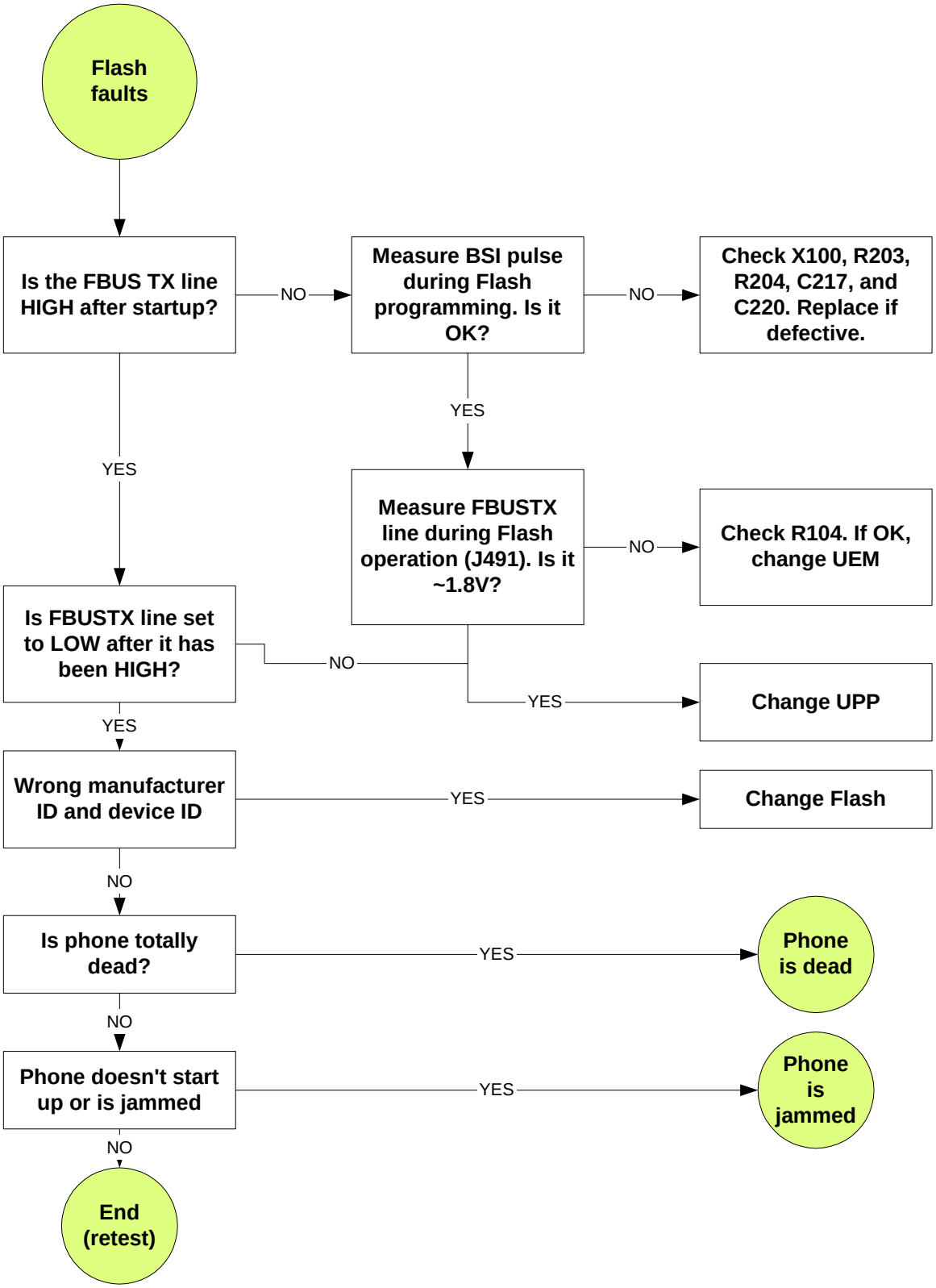
Flash Programming Fault



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Flash Programming Does Not Work

Flash programming procedure

1 The phone communicates with the prommer via the production test pattern, using the following signals:

- FBUSTX (serial data to phone)
- FBUSRX (serial data from phone)
- MBUS (serial clock for FBUSRX)
- VPP (external flashing voltage for speed up flashing)
- The BSI line also is used when initializing flashing (battery connector)

2 When the phone is powered (VBAT>3V), the MBUS and FBUSTX lines are pulled up internally by the phone.

3 The prommer sends a command to the UEM, using FBUSRX, to enter the Flash mode. During the sending of this command, the prommer keeps the BSI line high and MBUS is used as a serial clock.

4 When the Flash mode command is acknowledged, UEM enters the Flash mode and releases reset (PURX) to MCU.

5 After reset is released, UPP checks if there is a request for the Bootstrap code that resides in the UPP ROM.

6 The request for Bootstrap is the MBUS pulled down by the prommer (if the bootstrap is not requested, the bootstrap code jumps to FLASH SW).

7 If the Bootstrap code is requested, UPP enters the Flash mode and sets FBusTX to '0' as an acknowledgement to the prommer. This is an indication that UPP can run, at least, the fixed Bootstrap code — although it is not able to run the FLASH code. UPP then sends an UPP ID to the prommer via the FBUSTX line.

8 After the prommer has received the UPP ID, it sends a corresponding Secondary Boot Code to the phone via FBUSRX. The Secondary Boot Code, when run in UPP, requests UPP to send information to the prommer about the flash type and other HW-related parameters about the device to be flashed.

9 The prommer then sends the Algorithm Code corresponding to the HW parameters, and this algorithm, when run in UPP, takes over handling the MCUSW transfer to Flash.

10 To speed up flashing, 12 volts can be supplied to Vpp (by the prommer).

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11 The Flash program includes a package of MCU and DSP software and all default parameters for the phone. The tuning values will be added/rewritten during the Flash/Alignment phase.

Flash programming error codes

The various error codes can be seen from the FPS-8 Flash menu in Phoenix.

The underlined text in the following table indicates that the item under consideration is being used for the first time in the flashing sequence.

Table 15: Flash programming error codes

Error	Description	Not working properly
C101	"The Phone does not set FbusTX line high after the startup."	Vflash 1 VBatt BSI and FbusRX from prommer to UEM FbusTX from UPP->UEM->Prommer(SA0)
C102	"The Phone does not set FbusTx line low after the line has been high. The Prommer generates this error also when the Phone is not connected to the Prommer."	PURX(also to Safari) VR3 Rfclock(VCTCXO->Safari->UPP Mbus from Prommer->UEM->UPP(MbusRx)(SA0) FbusTx from UPP->UEM->Prommer(SA1) BSI and FbusRX from prommer to UEM
C103	"Boot serial line fail."	Mbus from Prommer->UEM->UPP(MbusRx)(SA1) FbusRX from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C104	"MCU ID message sending failed in the Phone."	FbusTx from UPP->UEM->Prommer
C105	"The Phone has not received Secondary boot codes length bytes correctly."	Mbus from Prommer ->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C106	"The Phone has not received Secondary code bytes correctly."	Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
C107	"The Phone MCU cannot start Secondary code correctly."	UPP
C586	"The erasing status response from the Phone informs about fail."	Flash
C686	"The programming status response from the Phone informs about fail."	Flash
Cx81	"The Prommer has detected a checksum error in the message, which it has received from the Phone."	FbuxTx from UPP->UEM->Prommer

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Table 15: Flash programming error codes

Error	Description	Not working properly
Cx82	"The PRommer has detected a wrong ID byte in the message, which it has received from the Phone."	FbuxTx from UPP->UEM->Prommer
A204 Cx83 Cx84 Cx85	"The flash manufacturer and device IDs in the existing Algorithm files do not match with the IDs received from the target phone." "The Prommer has not received Phone acknowledge to the message." "The Phone has generated NAK signal during data block transfer." "Data block handling timeout."	Flash UPP VIO/VANA? Signals between UPP-Flash Mbus from Prommer->UEM->UPP(MbusRx) FbusRx from Prommer->UEM->UPP FbusTx from UPP->UEM->Prommer
Cx87	"Wrong MCU ID."	RFClock UPP(Vcore)
Startup for flashing	Required startup for flashing	Vflash1 VBatt

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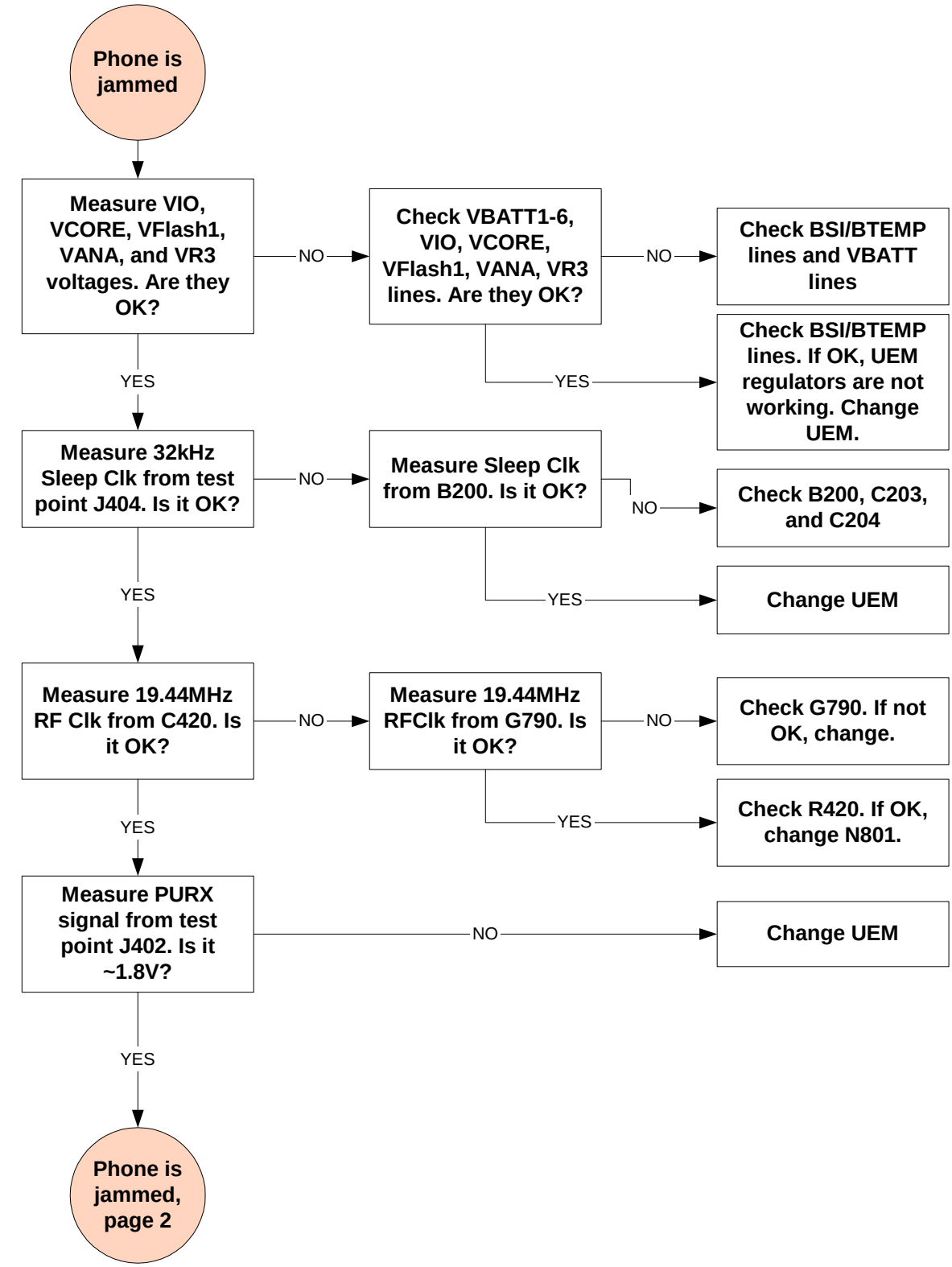
Phone is Jammed


Phone is jammed
Measure VIO, VCORE, VFlash1, VANA, and VR3 voltages. Are they OK?
NO
Check VBATT1-6, VIO, VCORE, VFlash1, VANA, VR3 lines. Are they OK?
NO
Check BSI/BTEMP lines and VBATT lines
YES
Check BSI/BTEMP lines. If OK, UEM regulators are not working. Change UEM.
YES
Measure 32kHz Sleep Clk from test point J404. Is it OK?
NO
Measure Sleep Clk from B200. Is it OK?
NO
Check B200, C203, and C204
YES
YES
Change UEM
Measure 19.44MHz RF Clk from C420. Is it OK?
NO
Measure 19.44MHz RFClk from G790. Is it OK?
NO
Check G790. If not OK, change.
YES
YES
Check R420. If OK, change N801.
Measure PURX signal from test point J402. Is it ~1.8V?
NO
Change UEM
YES
Phone is jammed, page 2

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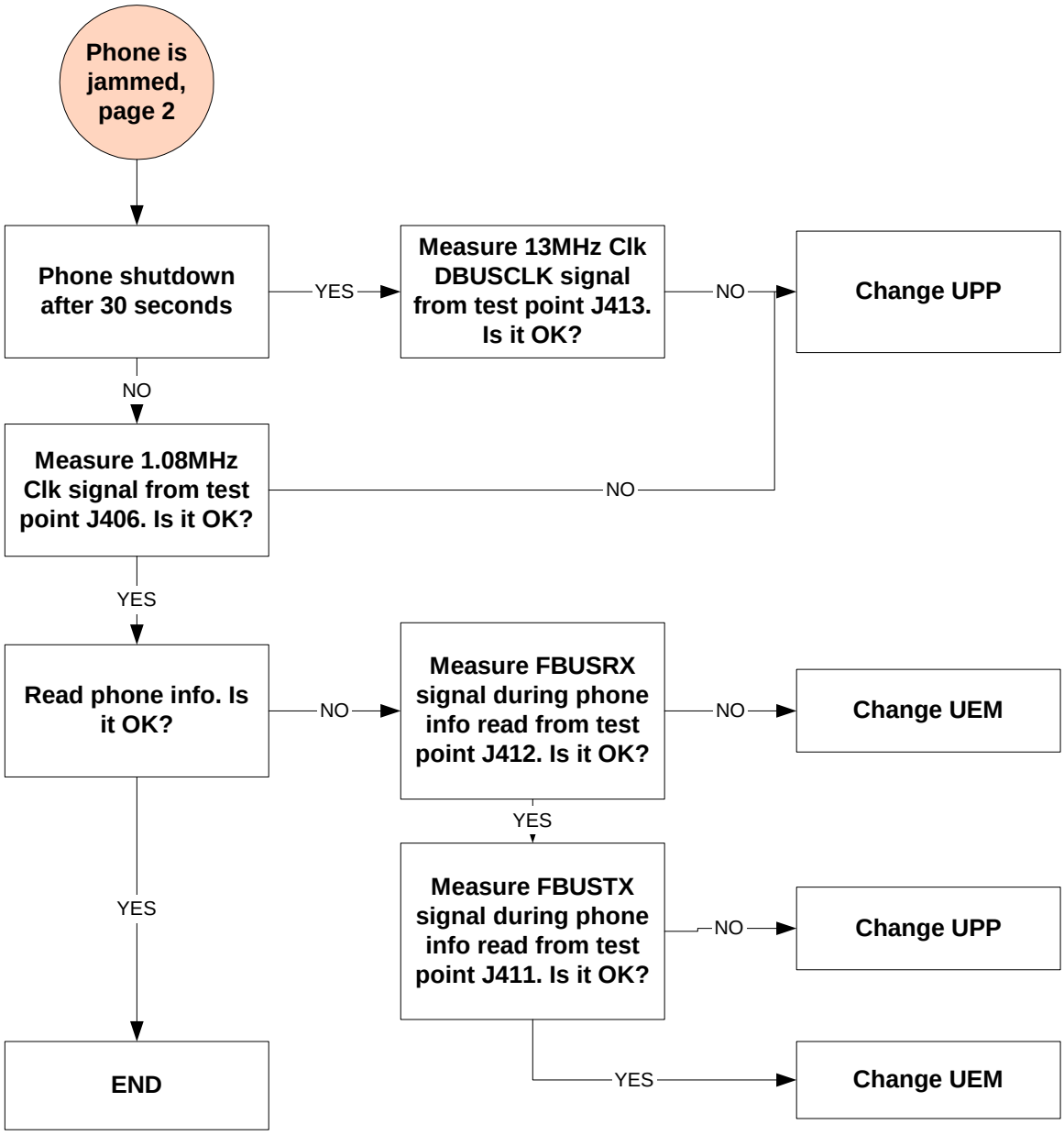

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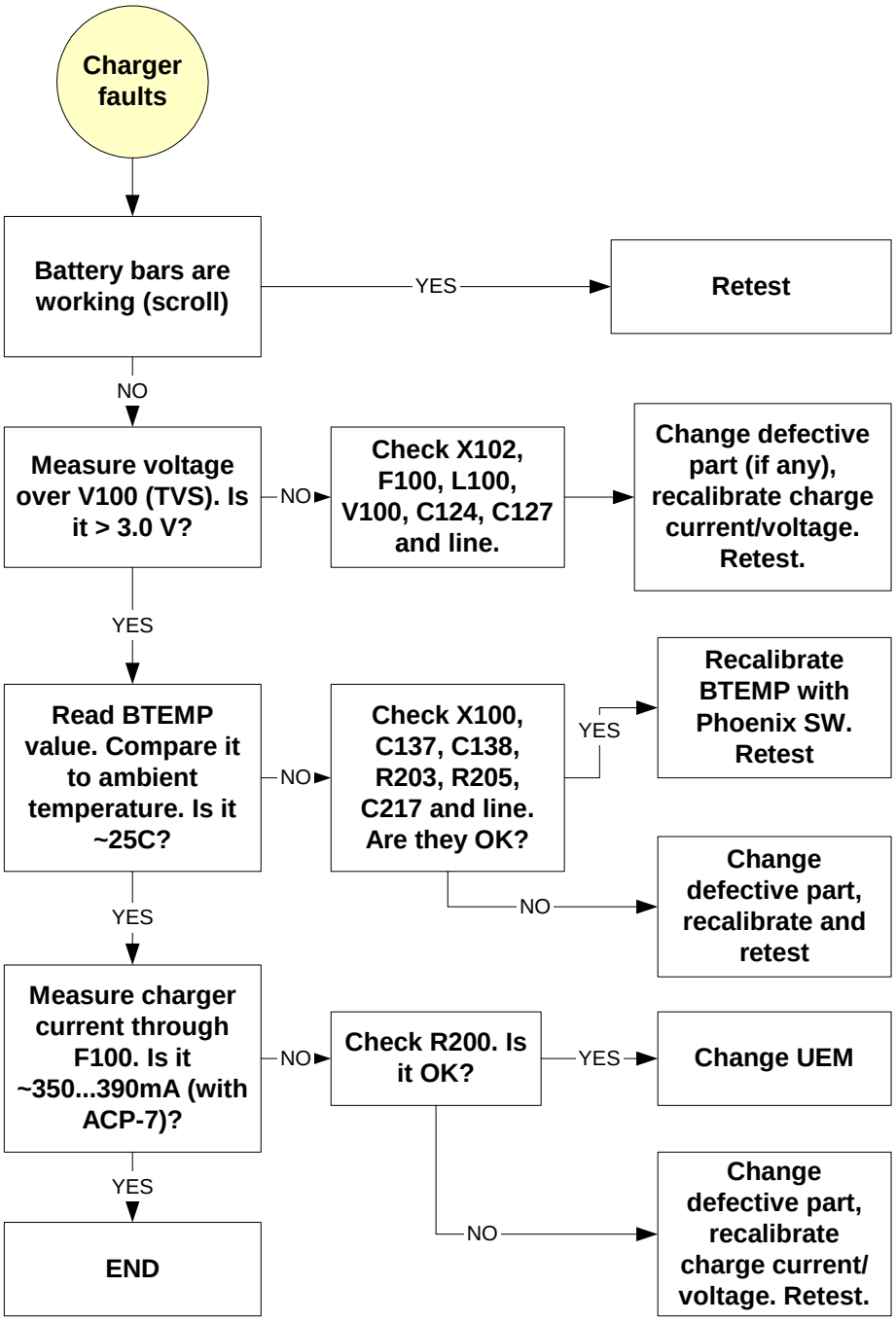
Charger Faults


Charger faults
Battery bars are working (scroll)
YES
Retest
NO
Measure voltage over V100 (TVS). Is it > 3.0 V?
NO
Check X102, F100, L100, V100, C124, C127 and line.
Change defective part (if any), recalibrate charge current/voltage. Retest.
YES
Read BTEMP value. Compare it to ambient temperature. Is it ~25C?
NO
Check X100, C137, C138, R203, R205, C217 and line. Are they OK?
YES
Recalibrate BTEMP with Phoenix SW. Retest
NO
Change defective part, recalibrate and retest
YES
Measure charger current through F100. Is it ~350...390mA (with ACP-7)?
NO
Check R200. Is it OK?
YES
Change UEM
YES
END
NO
Change defective part, recalibrate charge current/ voltage. Retest.

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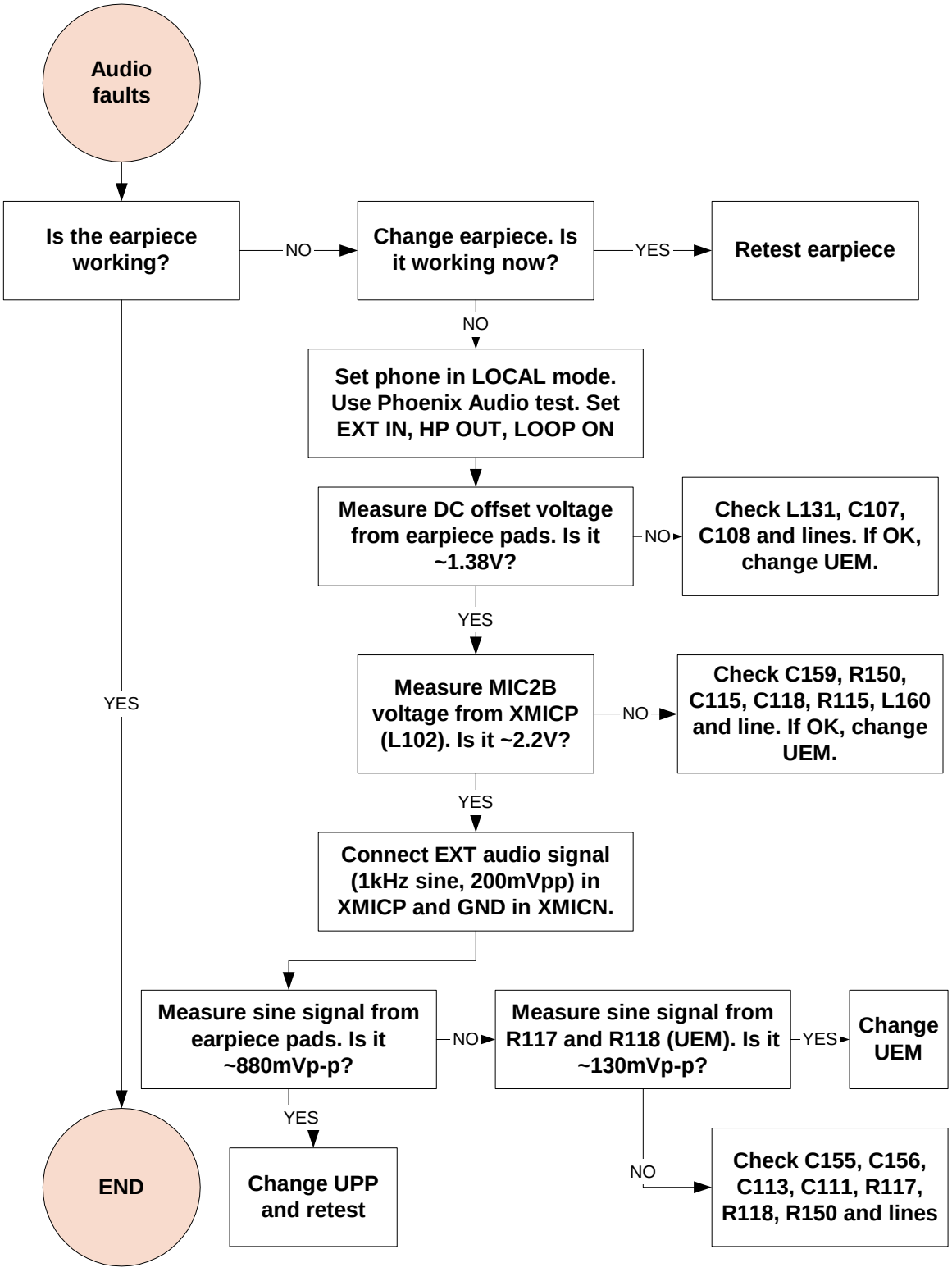
Audio Faults


Audio faults
Is the earpiece working?
NO
Change earpiece. Is it working now?
YES
Retest earpiece
NO
Set phone in LOCAL mode. Use Phoenix Audio test. Set EXT IN, HP OUT, LOOP ON
Measure DC offset voltage from earpiece pads. Is it ~1.38V?
NO
Check L131, C107, C108 and lines. If OK, change UEM.
YES
Measure MIC2B voltage from XMICP (L102). Is it ~2.2V?
NO
Check C159, R150, C115, C118, R115, L160 and line. If OK, change UEM.
YES
Connect EXT audio signal (1kHz sine, 200mVpp) in XMICP and GND in XMICN.
YES
Measure sine signal from earpiece pads. Is it ~880mVp-p?
NO
Measure sine signal from R117 and R118 (UEM). Is it ~130mVp-p?
YES
Change UEM
YES
Change UPP and retest
NO
Check C155, C156, C113, C111, R117, R118, R150 and lines
END

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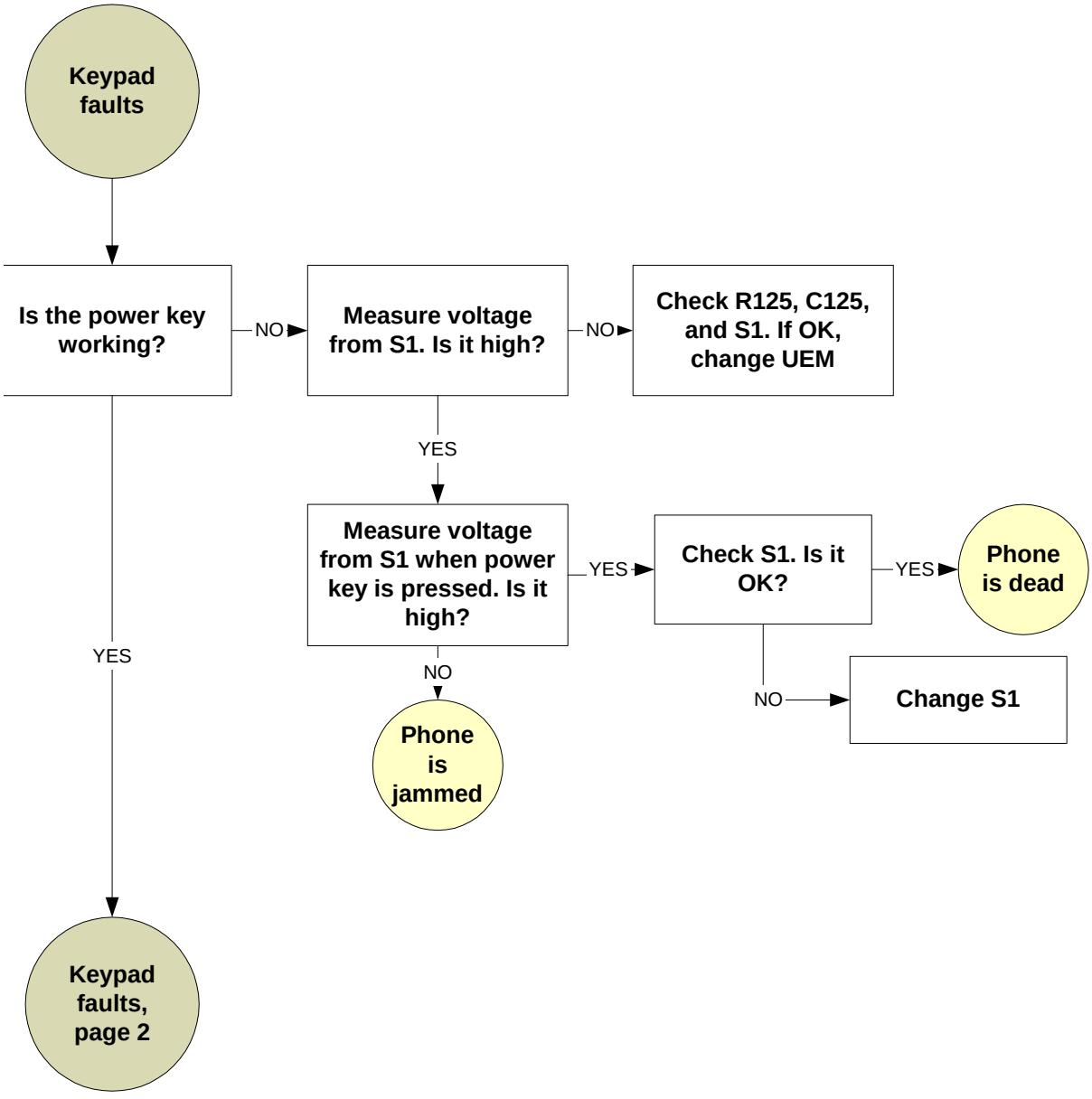
Keypad Fault



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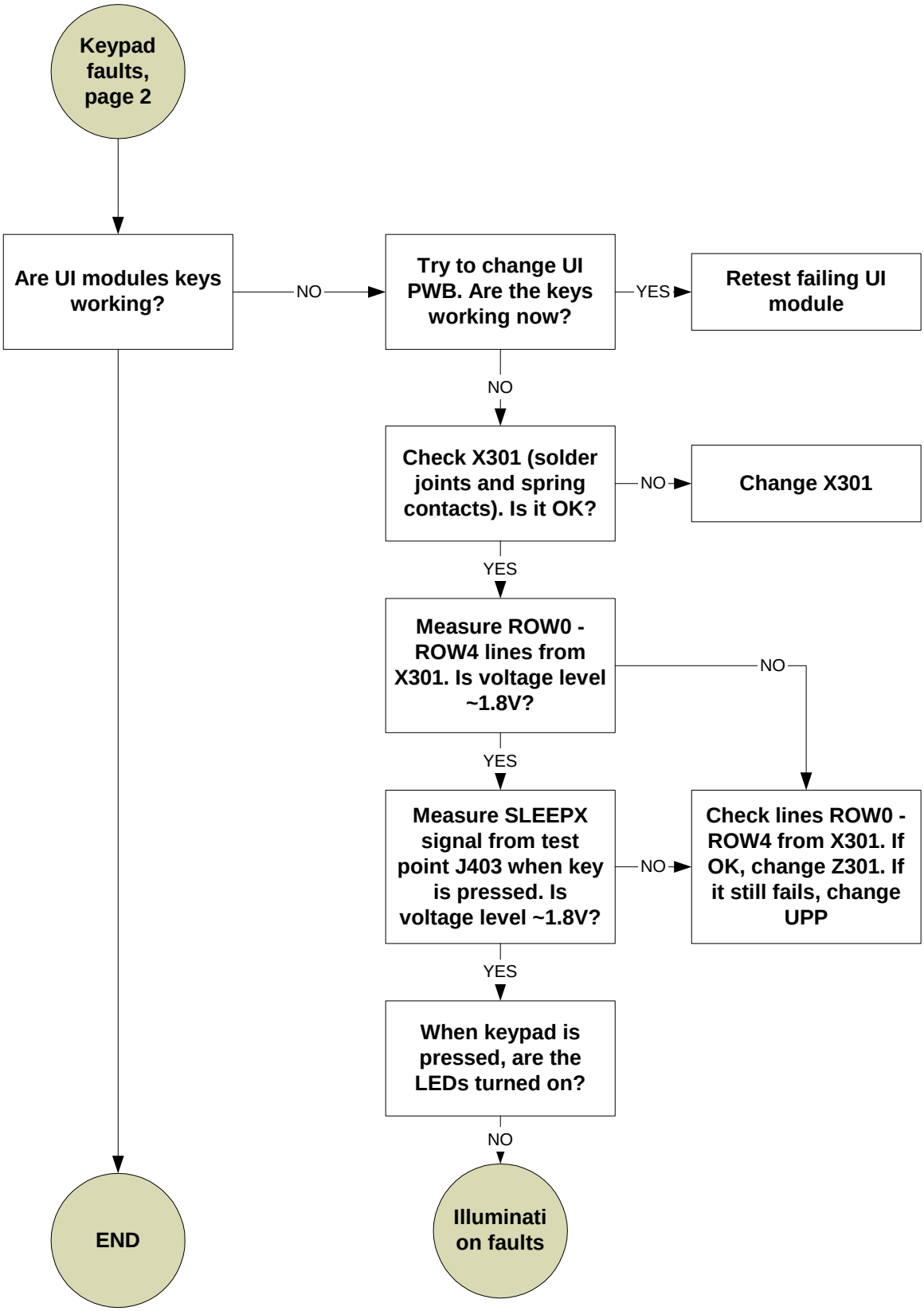
Keypad faults, page 2
Are UI modules keys working?
NO
Try to change UI PWB. Are the keys working now?
YES
Retest failing UI module
NO
Check X301 (solder joints and spring contacts). Is it OK?
NO
Change X301
YES
Measure ROW0 - ROW4 lines from X301. Is voltage level ~1.8V?
NO
YES
Measure SLEEPX signal from test point J403 when key is pressed. Is voltage level ~1.8V?
NO
Check lines ROW0 - ROW4 from X301. If OK, change Z301. If it still fails, change UPP
YES
When keypad is pressed, are the LEDs turned on?
NO
Illuminati on faults
END

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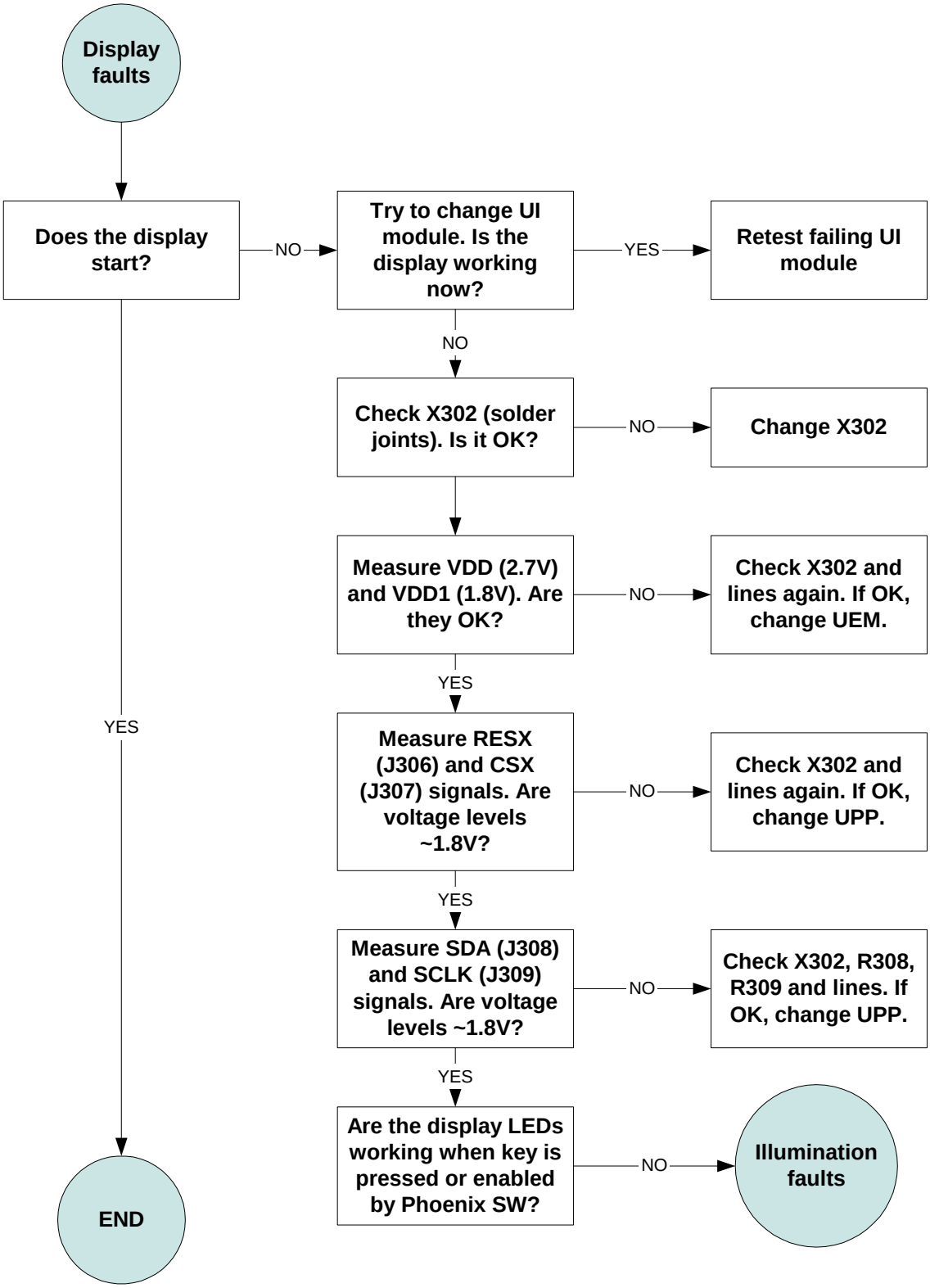
Display Fault


Display faults
Does the display start?
NO
Try to change UI module. Is the display working now?
YES
Retest failing UI module
NO
Check X302 (solder joints). Is it OK?
NO
Change X302
Measure VDD (2.7V) and VDD1 (1.8V). Are they OK?
NO
Check X302 and lines again. If OK, change UEM.
YES
YES
Measure RESX (J306) and CSX (J307) signals. Are voltage levels ~1.8V?
NO
Check X302 and lines again. If OK, change UPP.
YES
Measure SDA (J308) and SCLK (J309) signals. Are voltage levels ~1.8V?
NO
Check X302, R308, R309 and lines. If OK, change UPP.
YES
Are the display LEDs working when key is pressed or enabled by Phoenix SW?
NO
Illumination faults
YES
END

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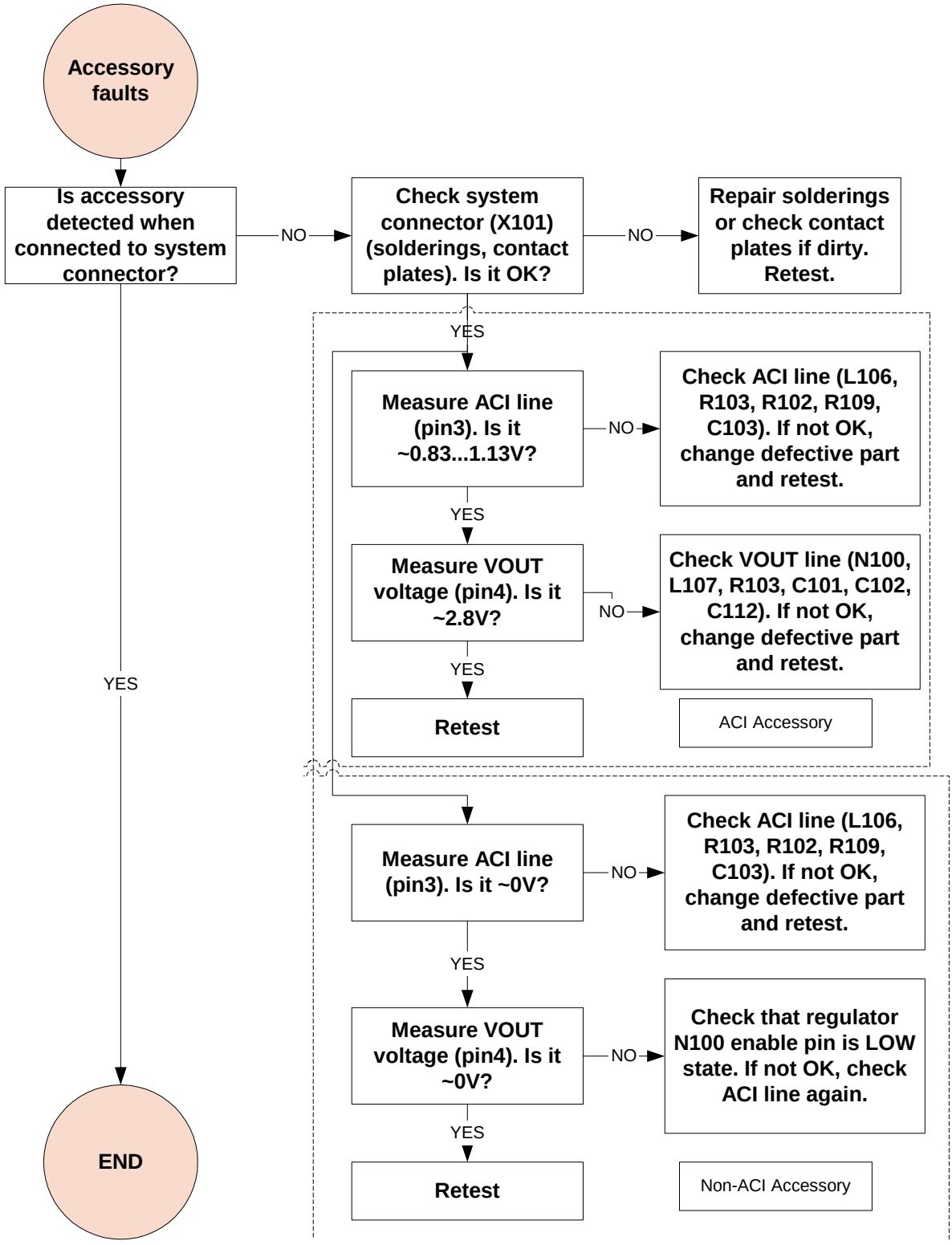
Accessory Faults


Accessory faults
Is accessory detected when connected to system connector?
NO
Check system connector (X101) (solderings, contact plates). Is it OK?
NO
Repair solderings or check contact plates if dirty. Retest.
YES
Measure ACI line (pin3). Is it ~0.83...1.13V?
NO
Check ACI line (L106, R103, R102, R109, C103). If not OK, change defective part and retest.
YES
Measure VOUT voltage (pin4). Is it ~2.8V?
NO
Check VOUT line (N100, L107, R103, C101, C102, C112). If not OK, change defective part and retest.
YES
Retest
ACI Accessory
YES
Measure ACI line (pin3). Is it ~0V?
NO
Check ACI line (L106, R103, R102, R109, C103). If not OK, change defective part and retest.
YES
Measure VOUT voltage (pin4). Is it ~0V?
NO
Check that regulator N100 enable pin is LOW state. If not OK, check ACI line again.
YES
Retest
Non-ACI Accessory
END

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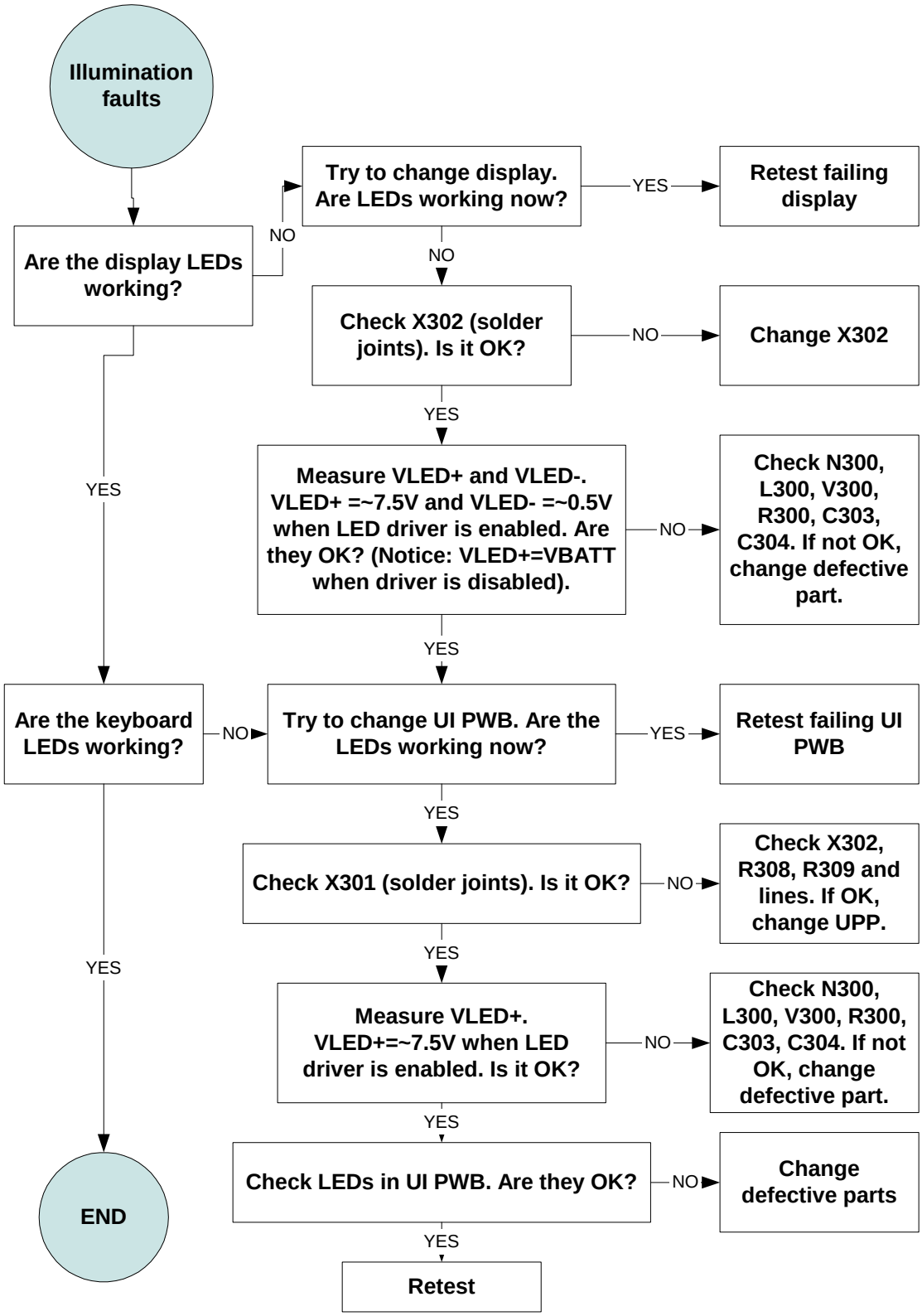
Illumination Faults


Illumination faults
Are the display LEDs working?
NO
Try to change display. Are LEDs working now?
YES
Retest failing display
NO
Check X302 (solder joints). Is it OK?
NO
Change X302
YES
Measure VLED+ and VLED-. VLED+ =~7.5V and VLED- =~0.5V when LED driver is enabled. Are they OK? (Notice: VLED+=VBATT when driver is disabled).
NO
Check N300, L300, V300, R300, C303, C304. If not OK, change defective part.
YES
YES
Are the keyboard LEDs working?
NO
Try to change UI PWB. Are the LEDs working now?
YES
Retest failing UI PWB
YES
Check X301 (solder joints). Is it OK?
NO
Check X302, R308, R309 and lines. If OK, change UPP.
YES
Measure VLED+. VLED+=~7.5V when LED driver is enabled. Is it OK?
NO
Check N300, L300, V300, R300, C303, C304. If not OK, change defective part.
YES
YES
END
Check LEDs in UI PWB. Are they OK?
NO
Change defective parts
YES
Retest

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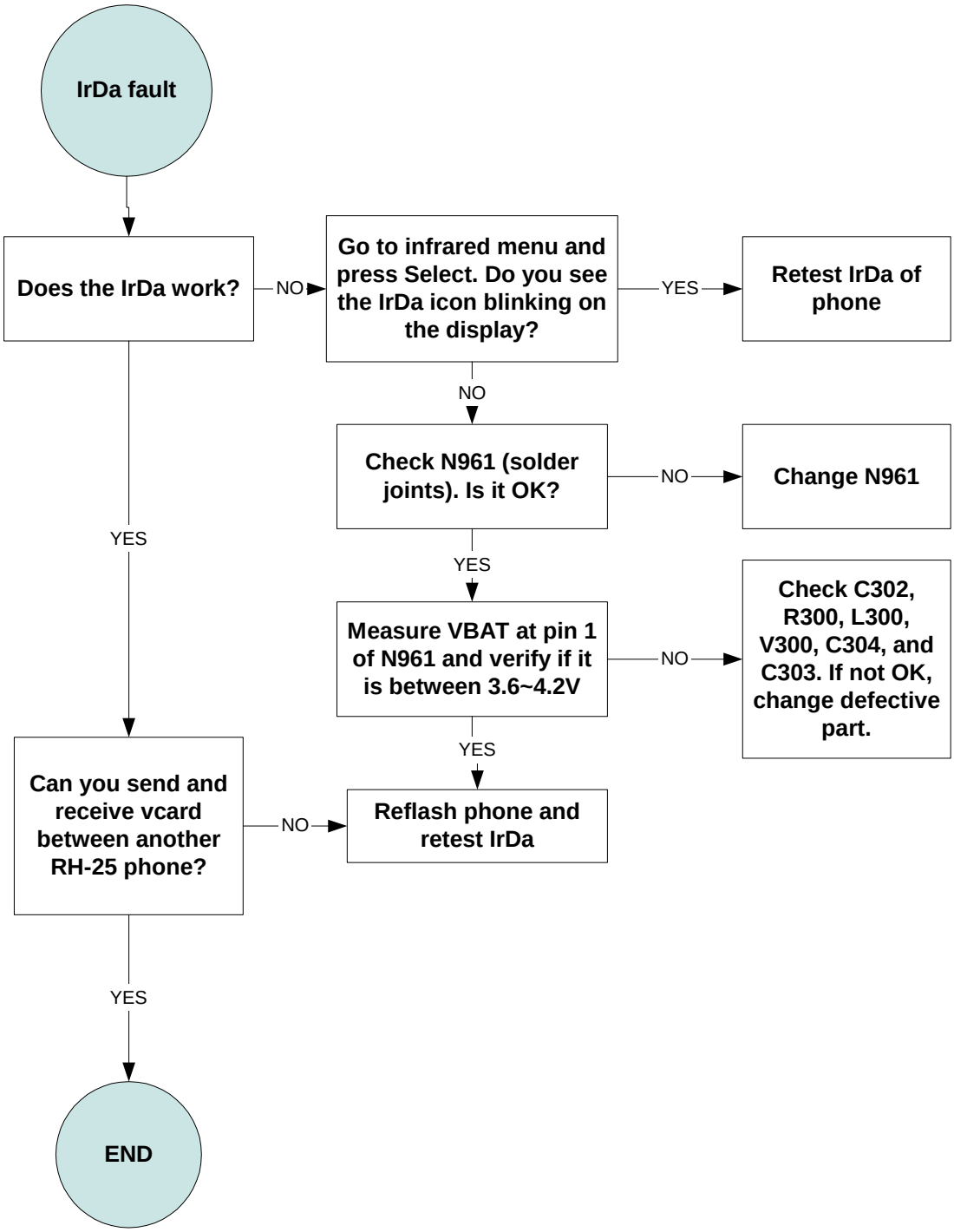
IrDa Fault


IrDa fault
Does the IrDa work?
NO
Go to infrared menu and press Select. Do you see the IrDa icon blinking on the display?
YES
Retest IrDa of phone
NO
Check N961 (solder joints). Is it OK?
NO
Change N961
YES
YES
Measure VBAT at pin 1 of N961 and verify if it is between 3.6~4.2V
NO
Check C302, R300, L300, V300, C304, and C303. If not OK, change defective part.
YES
Can you send and receive vcard between another RH-25 phone?
NO
Reflash phone and retest IrDa
YES
END

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